A CONTROL SOLUTION FOR TRANSMISSION POWER OF MOBILE HANDSET

FIELD OF THE INVENTION

The present invention relates to a wireless telecommunication system in TDD (Time Division Duplex) mode; and, more particularly, to an apparatus for controlling the transmitter power in TDD-based wireless telecommunication systems and its method thereof.

DESCRIPTION OF THE PRIOR ART

In wireless telecommunication systems, self-interference produced by the transmitter power of base stations and that of user equipments, has a direct influence upon the system performance. In an actual system, each user terminal transmits data using the minimal signal level in the case of reaching a certain Signal-to-Interference Ratio (SIR), so as to limit the harm that transmitter power brings to the telecommunication system.

In order to ensure the communication quality of the system and maintain the power of the signal to be transmitted at a desired level, it is necessary to compensate for unintentional gain fluctuations observed in various components of the transmit chain.

Gain calibration is the general means to compensate for unintentional gain fluctuations. However, gain fluctuations can be caused for various reasons when signals are transmitted, such as aging of components, changes in ambient temperature, air pressure, humidity level, saturation of amplifiers, and changes in the traffic load, and etc, any of which can lead to unexpected gain changes. So, it's impossible for calibration procedures to maintain the transmitter's output power at a certain level precisely all the time. Once these gain fluctuations occur, the operating points of telecommunication facilities will drift, and consequently the communication quality will degrade.

Therefore, a method based on control system is needed to make gain compensation. By comparing the expected output power with the actual output power, it is capable of adjusting the overall gain after various components of the transmit chain, thus compensating for the unintentional gain fluctuations.

A method of transmitter power tracking loop (TPTL) is disclosed in patent publication US 6286994B1, Sep.11, 2001. In this method, the actual output power level is obtained by detecting, sampling and filtering the actual output power, then the unintentional gain fluctuations are compensated by TPTL after using a series of complicated algorithms, so as to match the actual output power with an expected and calculated transmit power.

But this method is particularly used for base stations and is very complicated

indeed. It's still a hard problem to be solved in the art as how to provide a method and an apparatus for controlling transmitter power of a mobile terminal, by fully utilizing existing components of wireless telecommunication systems and without making much modification to them.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of the invention to provide an apparatus and its method thereof for controlling transmitter power of the wireless telecommunication systems in TDD mode, which capable of compensating effectively for various unintentional gain fluctuations in transmission chains, and thus to improve the system performance.

Another object of the present invention is to provide an apparatus and its method thereof for controlling transmitter power of the wireless telecommunication systems in TDD mode, which capable of compensating effectively for various expected gain fluctuations in transmission chains, and thus to improve the communication quality of the systems.

The third object of the invention is to provide an apparatus and its method thereof for controlling transmitter power of the wireless telecommunication systems in TDD mode, which nicely uses the existing transceiver hardware of the wireless telecommunication systems, and thus has such features as low cost and easy implementation.

To achieve the object above, a mobile terminal for the wireless telecommunication systems in TDD mode, as proposed in the present invention, comprising:

A transceiver, for receiving and transmitting radio frequency(RF) signals;

A front end unit, for selecting a receiver mode or a transmitter mode according to a control signal, and sampling a signal to be transmitted to generate a sampling signal when the mobile terminal is in the transmitter mode; and

A baseband processing unit, for providing the said control signal to the said front end unit, providing the said signal to be transmitted to the said front end unit when the mobile terminal is in the transmitter mode, and generating a power compensation signal to adjust the power of the said signal to be transmitted output from the front end unit according to the said sampling signal from the said front end unit.

To realize the object above, a method for a mobile terminal in TDD mode wireless telecommunication systems, as proposed in the present invention, comprising:

Selecting a receiver mode or a transmitter mode;

Separating a signal to be transmitted into the main signal and the sampling signal, transmitting the main signal and outputting the sampling signal as a

feedback signal, when the mobile terminal is in the transmitter mode;

Generating a power compensation signal to adjust the power of the signal to be transmitted according to the said sampling signal.

BRIEF DESCRIPTION OF THE DRAWINGS

Further description of the invention will be given below, in conjunction with the accompanying drawings, wherein:

Fig. 1 illustrates the structure of a current multi-band, multi-mode transceiver.

Fig. 2 provides the structure of the multi-band, multi-mode transceiver, proposed in the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

TD-SCDMA is a telecommunication system based on TDD mode, so the preferred embodiment will unfold a detailed description of the invention, in conjunction with the accompanying drawings, by taking a mobile terminal in TD-SCDMA as an example.

Comparing the multi-band, multi-mode transceiver in the present invention as indicated in Fig. 2 with a current one as shown in Fig.1, it can be seen that the transceiver in the present invention additionally has a sampling unit, as coupling unit 3, a sampling switch, as coupling switch 21, and a power compensation signal generating module, as TPTCL (transmitter power tracking and controlling loop)

signal generating module 22. How it works and how it connects with components in current transceivers will be presented as follows.

As shown in Fig. 2, the multi-band, multi-mode transceiver in the present invention consists of a transceiver, as antenna 1, a front-end unit 6, and a baseband processing unit 16.

The said front-end unit 6 consists of a switch unit 2, a coupling unit 3, a transmitting module 4, and a receiving module 5.

The said baseband processing unit 16 consists of a transmitting baseband processing unit 7, a receiving baseband processing unit 8, a control unit 15 and a TPTCL signal generating module 22.

Wherein the switch unit 2 is composed of transmitter/receiver mode selection switch 20 and coupling switch 21; TPTCL signal generating module 22 consists of expected power calculating unit 9, actual power calculating unit 10, comparison unit 11, adding unit 13 and DAC unit 14.

In TDD mode, when the control signal from control unit 15 indicates receiver mode or transmitter mode, the transceiver works as follows:

1. Receive wireless signals

When the transceiver is in the mode to receive wireless signals, transmitter/receiver mode selection switch 20 in switch unit 2 switches antenna 1 to

be connected with receiving module 5, RF signals received from antenna 1 will be transmitted to receiving module 5 by transmitter/receiver mode selection switch 20, and demodulated in receiving module 5, then the demodulated signals will be transmitted to receiving baseband processing unit 8 in the baseband processing unit 16, where the general baseband receiving and processing are to be done.

When the transceiver in the present invention is in receiver mode, it works the same as current ones, and the transmitter composed of transmitting module 4 and transmitting baseband processing unit 7, doesn't work at all.

2. Transmit wireless signals

When the transceiver is in the mode to transmit wireless signals, the transmitter/receiver mode selection switch 20 in switch unit 2 switches antenna 1 to be connected with coupling unit 3, at the same time, coupling unit 21 in switch unit 2 will be connected with coupling unit 3 and receiving module 5 respectively. After being modulated, amplified and filtered by transmitting module 4, the main signal of the transmitter signal from transmitting baseband processing unit 7 in baseband processing unit 16, is transmitted from antenna 1 by transmit/receive mode selection switch 20, and a small part of the transmitter signal is input to receiving module 5 as coupling signal by coupling switch 21.

In receiving module 5, after being demodulated, the coupling signal input is transmitted to receiving baseband processing unit 8 in baseband processing unit

16.

In baseband processing unit 16, the signal that has been processed by receiving baseband processing unit 8, is transformed to signal in digital domain, and then transmitted to actual power calculating unit 10.

In actual power calculating unit 10, the actual output power can be calculated according to the digital signal input.

Meanwhile, in expected power calculating unit 9, the expected output power can be calculated according to transmit baseband processing signal in digital domain provided by transmitting baseband processing unit 7.

The expected output power calculated and the actual output power calculated will be respectively input to comparison unit 11, where the expected output power and the actual output power are compared periodically, and then an error signal is generated. The error signal can be used to obtain a power comparison signal in digital domain after being calibrated, such as a TPTL signal, which is to be input to adding unit 13.

In adding unit 13, a TPC signal from transmitter power control unit 12 in transmitting baseband processing unit 7 will be combined with the said TPTL signal, and the combined signal is input to DAC unit 14. After digital/analog conversion in DAC unit 14, the power compensation signal in analog form will be obtained, such

as a TPTCL signal, which can be used to control the AGC (automatic gain control) in transmitting module 4 of front-end unit 6.

With this TPTCL signal, the AGC in transmitting module 4 of front-end unit 6 will adjust the power of the signal to be transmitted from transmitting baseband processing unit 7 in baseband processing unit 16, to compensate for various unintentional gain fluctuations in the transmission chain.

With the unintentional gain fluctuations being compensated, RF signal modulated, amplified and filtered by transmitting module 4 will be transmitted via coupling unit 3, transmitter/receiver mode selection switch 20 and antenna 1.

As shown in the description of the preferred embodiment of the present invention, in conjunction with the accompanying drawings, the essence of the invention is: the sampling value of the actual transmitter power can be obtained by a sampling module mainly composed of coupling unit 3 and switch unit 2, the difference between the actual output power and the expected output power can be acquired by a power judging module mainly composed of actual power calculating unit 10 and comparison unit 11, and the power compensation signal can be generated to adjust the level of the actual output power by a power compensation module mainly composed of adding unit 13 and transmitter power control unit 12.

The present invention relates to an apparatus and its method thereof for controlling the transmitter power of mobile terminal in TDD mode wireless

telecommunication system. When signals are transmitted, a small part of output signal is taken as the coupling signal, and fed back to baseband processing unit 16 by coupling switch 21. According to the said coupling signal, TPTCL signal generating module 22 in baseband processing unit 16 generates the TPTCL signal to adjust the power of the signal to be transmitted, thus the apparatus and its method described in the present invention can effectively compensate for various unintentional gain fluctuations observed in various components of the transmit chain, and improve the performance of the telecommunication system.

Further, when TPTCL signal is generated, TPC signal provided by transmitting baseband processing unit 7 is also utilized, so the apparatus and its method described in the present invention can effectively compensate for various expected gain fluctuations observed in various components of the transmit chain, and improve the communication quality of the system.

Additionally, when TPTCL signal is generated, receiving module 5 and receiving baseband processing unit 8 are utilized to process the coupling signal, so the apparatus and its method described in the present invention can make hardware design simple, improve the performance of the telecommunication system and lower the cost.

Of course, while the invention has been shown and described with respect to the preferred embodiment, it will be understood by those skilled in the art that it

may not be limited to mobile terminals in TDD mode systems, but also applicable for base stations in TDD mode systems.

At the same time, while the invention has been shown and described with respect to the preferred embodiment, it will be understood by those skilled in the art that it may not be limited to TDD mode TD-SCDMA system, but also applicable for other TDD mode wireless telecommunication systems.

While the invention has been shown and described with respect to the preferred embodiment, it will also be understood by those skilled in the art that modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.